billows were floating below us. These, tho wonderfully beautiful, dyed in the rich colors of the declining sun, shut off the greater portion of the island from our view. On my previous visit to Etna, in May, 1884, the atmosphere was much clearer. Then we could see the greater part of the island. The entire east coast was outstretched below us. The billows of the sea breaking upon the rocky coast gave it a silvery edging. Two cities and a vast number of villages and hamlets incrusted the seashore, dotted the valleys, and nestled on the hillside. The Sicilian Mountain chains rose about us in great irregular ridges, crest peeping over crest. Stromboli to the north (seemingly but a stone's throw away), protruded his rocky head and shoulders above the sea. He was throwing a dense column of black smoke thousands of feet into the heavens. Adjacent was the little island volcano throwing upward white puffs of clouds. Mount Etna at the same time was shooting upward an immense column of sulphurous steam, rendering it impossible to see much of the interior of the crater. An inky black cloud hung below us at the west. From it came zig-zag chains of lightning flashes and thunder peals. We looked down upon the storm; it was raining below us, but we were in the sunshine above.

When the heavens are free of clouds the whole island, with its innumerable mountain peaks, is visible from the rim of the crater. With a glass the waves of the sea may be seen breaking in foam upon the rocky coast of the entire island. Malta is visible in the south, Stromboli and the Lipari Islands to the north, the Aegedian Islands to the west, and the three great seas of the Mediterranean—the Ionian, the African, and the Tyrrhian.

The sun was low down in the west and seemed to swim in a sea of glory. A stratus of clouds lay low in the heavens shutting off all view from the west. The stratus did not resemble clouds, but looked like a vast sea flecked with gold by the setting sun. As the sun neared the western horizon, it cast a great purple shadow of Etna against the eastern sky. It was triangular shaped and seemed to hang vertically in the heavens. For a time the rising moon shone with its silver light in the very apex of the purple pyramid. It was the strangest and most beautiful scene my eyes ever beheld.

DUSTFALL IN IDAHO.

Under date of April 18, 1908, Mr. F. Roch, the special observer of Wallace, Idaho, writes:

Twice within the past ten days we have had rainfalls so heavily charged with dust—the dust in dry form falling in flakes the size of a pinhead—that they might be called dustfalls instead of rain. These specks of dust came down as straight as it would be possible for a gentle rain to fall, and the fall continued for several hours intermittently.

This large quantity of dust must have had a special origin nearby and we hope that Mr. Roch will trace it to its source.—EDITOR.

METEOROLOGICAL EDUCATION.

In connection with the statistics of educational work by Weather Bureau officials, the editor would be glad to know of stations at which such work could be done more satisfactorily than now if some one especially fitted as teacher were attached to the local office force. Of course the teaching is only a small part of the official work, but it is well to have it done creditably to the Bureau. The subject is really so important and so interesting that we think colleges and academies will certainly take pride in being pioneers in the work.—EDITOR.

THE LAW OF THE EARTH'S NOCTURNAL COOLING.

By Prof. WILLIAM H. JACKSON. Dated Haverford College, Haverford, Pa., May 13, 1908.

In 1872 A. Weilenmann[1] showed that the normal temperature curve from sunset to sunrise may be represented by a formula appropriate to the Newtonian rate of cooling, that is by

$$\theta = \theta_0 + C\,b^t \qquad (1)$$

where t denotes the time measured in hours from midnight, θ the temperatures at time t, and θ_0, C, b are constants chosen to fit the observations as well as possible. Further, he found the striking agreement between the values of b for different places, as shown in the following table:

TABLE 1.—*Values of b for different places.*

Place.	Log b.	Duration of observations, in years.
Hobarton	$\bar{1}.934$	8
Berne	$\bar{1}.935$	7
Great St. Bernard	$\bar{1}.936$	19
St. Petersburg	$\bar{1}.938$	16
Ghent	$\bar{1}.939$	24
Prague	$\bar{1}.939$	13
Toronto	$\bar{1}.940$	6
Batavia	$\bar{1}.942$	3

In 1888 M. Alfred Angot[2] found that the corresponding values of log b for St. Maur, near Paris, were $\bar{1}.940$ for clear nights and $\bar{1}.936$ for cloudy nights. This is an independent confirmation of Weilenmann's results, and seems to show what might perhaps be inferred from those previous results, that the value of b is practically independent of the state of the atmosphere.

I was informed of these facts early in 1906, when Prof. Arthur Schuster drew my attention to a paper by Dr. S. Tetsu Tamura,[3] which gives an excellent account of the whole subject. At the same time he suggested that the facts could probably be explained by supposing that the earth radiated like a black body and that the question might be treated as one of heat conduction.

Attempts to treat the matter theoretically only led to two negative conclusions. First: It is unlikely that such a law can represent the actual facts, because such a law implies a solution of the differential equations to be solved of the form

$$\theta = f(x)\,e^{-kt},$$

where x denotes the distance from the surface of the earth. Such a law as this implies that all temperatures are decreasing at the same rate; whereas we know that the relative temperatures of the earth and atmosphere vary considerably in the course of the night. Secondly: If such a law represented the state of affairs, the coefficient b would vary from place to place, according to the nature of the ground.

Or we may look at the question from a purely theoretical point of view. Following Riemann,[4] the solution of the problem of the cooling of a very large conducting sphere, originally everywhere at unit temperature, and radiating heat into space at a rate proportional to the constant h, allows the surface temperature to be exprest by the formula,

$$\theta = 2\pi^{-\frac{1}{2}}\,h e^{a^2h^2t}\int_{a\sqrt{t}}^{\infty} e^{-h^2s^2}\,ds \qquad (2)$$

where a is the diffusivity of the sphere. Extending this formula to the case of a sphere normally in a steady state of heat flow, but which has been subjected to a uniform increase of temperature, and which is then left to return to its original normal condition, we obtain the series,

$$\theta = \theta_0 + \theta'\left(1 - 2\pi^{-\frac{1}{2}}\,aht^{\frac{1}{2}} + a^2h^2t + \tfrac{2}{3}\pi^{-\frac{1}{2}}\,a^3h^3t^{\frac{3}{2}} + \ldots\ldots\right) \qquad (3)$$

To obtain a more approximate solution for the actual case of the earth, we should of course suppose that the disturbance from the normal state was not a uniform increase of temperature, but a complicated function, decreasing as the distance below the surface of the earth increases. I have not thought it worth while to attempt this, because as explained, later, I believe the problem is best attacked by other methods.

[1] Ueber den täglichen Gang der Temperatur in Bern. Schweizerische Meteorologische Beobachtungen. Band IX. 1872.

[2] Influence de la Nébulosité sur la variation diurne de la température à Paris. Annales du Bureau Central. 1888.

[3] Mathematical Theory of Nocturnal Cooling of Atmosphere. Monthly Weather Review, April, 1905.

[4] Partielle Differentialgleichungen und deren Anwendung auf physikalische Fragen. Par. 69, 3d Edit. 1882. The same result is obtained by a different method by Carslaw, Fourier's Series and Integrals. 1906. P. 246.